Indian Journal of Agronomy **58** (3): 309–315 (September 2013)

Research Paper

Effect of integrated nutrient management on the performance of sole and intercropped pigeonpea (*Cajanus cajan*) under rainfed conditions

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Received : September 2012; Revised accepted : August 2013

ABSTRACT

A field experiment was conducted during *kharif* seasons of crop years (July-June) 2008-09 and 2009-10 at Varanasi to find out the effect of integrated nutrient management (INM) on the growth, yield, economics, nutrient uptake and balance sheet of sole and intercropped of pigeonpea {*Cajanus cajan* (L.) Millsp.} and blackgram {*Vigna mungo* (L.) Hepper} in 1:1 normal planting (60 cm spacing) and 2:2 paired row planting (40/80 cm). Intercropping system had significant effect on gross returns, net returns, B:C ratio and monetary advantage index (MAI), total uptake of N,P,K,S and Zn, when compared to sole pigeonpea. Higher values of gross returns, net returns, B:C ratio and MAI were recorded under normal intercropping system followed by paired intercropping system. Significantly higher values of total uptake (N,P,K,S and Zn) was recorded under sole pigeonpea. The lowest negative value of actual gain of S and Zn was recorded under paired intercropping. Among the integrated nutrient management, application of 100% RDF + 50% of RDN through vermicompost + 5 kg Zn/ha gave significantly higher growth and yield attributes, grain yield, gross returns, net returns, B:C ratio, MAI and total uptake (NPKS and Zn) of both crops. The lowest N/P/K/S efficiency ratio and physiological efficiency index of cropping systems were recorded under application of 100% RDF + 50% NVC + 5 kg Zn/ha followed by 50% RDF + 100% NVC + 5 kg Zn/ha. Application of 100% RDF + 50% NVC + 5 kg Zn/ha recorded significantly higher total uptake and available soil S and Zn after harvest of crop. Maximum negative value of actual gain of S and Zn was also recorded with the application of 100% RDF + 50% NVC + 5 kg Zn/ha.

Key words **:** Intercropping, Integrated nutrient management, Nutrient uptake, Rainfed pigeonpea

Pigeonpea is the fifth prominent grain legume crop in the world and occupies the second position in India after chickpea. Pigeonpea, a deep rooted crop with slow initial growth rate between 45 and 60 days after sowing is well suited for intercropping. Intercropping is an intensive land use system with an objective to utilize the space between the rows of main or base crop and to produce more produce/unit area. The space between the rows could be effectively utilized by growing a short duration crop, which may generate an additional income without adversely affecting the yield of pigeonpea (Jat and Ahlawat, 2010). Blackgram being an efficient cover crop fits well in this system. The greatest limitation of increasing productivity of these crops is inadequate supply of nutrients since the soils of arid region are poor in native fertility and continuous application of inorganic fertilizers even in balanced from may not sustain soil fertility and productivity. However, judicious use of chemical fertilizers in combination with organic manures is required to improve the soil health as well as achieve sustainable crop production. Thus, balanced fertilization along with sound crop husbandry offers a great scope for increasing productivity. Keeping this in view, a field experiment was undertaken to improve the productivity and soil fertility of pigeonpea and blackgram intercropping system with integrated nutrient management under rainfed condition.

MATERIALS AND METHODS

A field experiment was conducted at Institute of Agricultural Sciences, Banaras Hindu University at Varanasi on sandy clay loam soil during *kharif* 2008-09 and 2009-10. The soil of the experimental site had a pH of 7.3, containing 0.35% organic carbon, 190.5 kg/ha available N, 19.3 kg/ha available P, 210.2 kg/ha available K, 18.6 kg/

Based on Ph.D. Thesis of first author submitted to Institute of Agricultural Sciences, BHU, Varanasi, 221 005 (Unpublished)

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ha available S and 0.51 ppm available Zn. Total rainfall received during the crop season was 529 mm and 420 mm during 2008-09 and 2009-10, respectively. The treatment combinations comprised three cropping systems [Pigeonpea sole (60 cm), normal planting (60 x 20 cm) + blackgram (1 row) and paired row planting (40/80 cm and 20 cm) + blackgram (2 rows)] in main plots and nine integrated nutrient management levels (control, 100% recommended dose of fertilizer (RDF), 50% RDF + 50 % NVC (recommended dose of 20 kg N/ha through vermicompost) 100% RDF + 50% NVC, 50% RDF + 100% NVC, 100% RDF + 5 kg Zn/ha, 50% RDF + 50% NVC + 5 kg Zn/ha, 100% RDF + 50% NVC +5 kg Zn/ha and 50% RDF + 100% NVC + 5 kg Zn/ha) in sub-plots. Recommended dose of fertilizer was 40 kg P_2O_5 and 20 kg each of N, K_2O and S per hectare. All the doses of nitrogen, phosphorus, potassium, sulphur and zinc fertilizers were applied as per treatment just before sowing using urea, diammonium phosphate, muriate of potash, elemental sulphur and zinc oxide, respectively as basal. The required amount of NVC through vermicompost containing N (1.5%), P (0.90%), K (1.12%), S (0.56) and Zn (58 ppm) was incorporated as per treatment in the soil after preparing the layout and demarcating the plots during both the years. 'Bahar' variety of pigeonpea and 'T-9' variety of blackgram were used as test crop. The seeds of both the crops at the rate of 15 kg/ha (pigeonpea) and 12 kg/ha (blackgram) were sown in rows. Grain and stover were dried, processed and analyzed for N, P, K, S and Zn content for working out nutrient uptake during both the years. The sulphur and Zn content in soil were determined by turbidimetric method (Chesnin and Yien, 1950) and atomic absorption spectrophotometry method (Lindsay and Norvell, 1978), respectively. The data recorded were analyzed as per analysis of variance technique for split-plot design. Efficiency ratio of different nutrients were calculated by using the formula:

$$\text{N/P/K/S efficiency ratio} = \frac{\text{Dry matter yield at harvest (kg/ha)}}{\text{N/P/K/S accumulation in crop at harvest (kg/ha)}}$$

Physiological efficiency index of absorbed N/P/K/S of the treatments were calculated as ratio of kg grain produced to a kg of N/P/K/S absorbed in above ground dry matter at harvest (Rana *et al*., 2006).

RESULTS AND DISCUSSION

Productivity of pigeonpea

Sole pigeonpea recorded maximum growth, yield attributes and yield except plant height (Table 1). However, intercropping system of pigeonpea + blackgram did not affect the growth, yield attributes and yield of pigeonpea. This might be due to the absence of competition between main crop and intercrop for growth resources such as nutrients, moisture, solar radiation and shorter duration and non-spreading nature of blackgram. The results are in close conformity with the findings of Kumar and Rana (2007) and Meena *et al*. (2009).

Among the integrated nutrients management treatments, application of 100% RDF + 50% NVC + 5 kg Zn/ha and 50% RDF + 100% NVC + 5 kg Zn/ha were equally effective and significantly superior to the rest of the treatments with respect of growth (plant height and branches/plant), yield attributes (pods/plant and 1,000-grains weight) and grain yield of pigeonpea (Table 1). The quantum difference in seed yield was 900 kg/ha, which is in terms of percentage was 74.7 due to application of 100% RDF + 50% NVC + 5 kg Zn/ha over control. The increase in growth, yield attributes and yield might be due to the beneficial effect of combined use of organics with balanced inorganic fertilization to the extent of 100% RDF + 50% NVC + 5 kg Zn/ha. Thus, increased rate of photosynthetic and symbiotic activity following balanced application of NPKS and Zn and vermicompost, stimulated better vegetative and reproductive growth of the crop resulting in higher grain yield. The better performance of vermicompost might be on account of readily available plant nutrient, growth enhancing substances and number of beneficial organisms like N_2 fixing and P solubilizing and cellulose decomposing organisms (Bark and Gulati, 2009). These results corroborated the findings of Saritha *et al*. (2012).

Economics

Both intercropping treatments were more remunerative with higher gross return, net return, B:C ratio and MAI as compared to sole cropping (Table 2). Normal planting system fetched higher gross returns (₹ 120.1 × 10^3/ha), net returns (₹99.4 × 10^3/ha), B: C ratio (4.8) and MAI (₹31.6 ×10^3/ha), which was at par with paired row planting system and significantly superior to sole cropping of pigeonpea. This might be due to additional yield of blackgram with similar yields of pigeonpea in sole and intercropping, which resulted in higher gross returns, net returns, B:C ratio and MAI in normal planting system (S_2) when compared with sole pigeonpea. The results are in conformity with the findings of Jat and Ahlawat (2010) and Kumar *et al*. (2013). Further pooled data revealed that maximum gross returns (₹130.7 × 10^3/ha), net returns (₹109.3 × 10^3/ha), B:C ratio (5.1) and MAI (₹25.6 ×10^3/ha) were found with 100% RDF + 50% NVC + 5 kg Zn/ha. It was closely followed by 50% RDF + 100% NVC + 5 kg Zn ha and minimum were in control. Similar findings were also reported by Vyas *et al*. (2006).

Total nutrient uptake by pigeonpea

Total uptake of plant nutrients was significantly higher with sole cropping system as compared to normal and paired planting systems (Table 3). This might be due to compound effect of grain and stalk yield and content of nutrients. Similar results were also reported by Kumar *et al*. (2012). Data revealed that total uptake of N, P, K, S and Zn by pigeonpea differed significantly due to different

Table 1. Growth, yield attribute and yield of pigeonpea and blackgram as influenced by cropping system and integrated nutrient management (Pooled data of two years)

Treatment	Pigeonpea					Blackgram				
	Plant height (cm)	Branches/ plant	Pods/ plant	1,000-grains weight (g)	Seed yield (t/ha)	Plant height (cm)	Branches/ plant	Pods/ plant	1,000-grains weight (g)	Seed yield (t/ha)
Cropping system										
Pigeonpea sole (60 × 20 cm)	202.3	19.1	287.2	98.2	1.84	-	-	-	-	-
Normal planting of pigeonpea (60 × 20 cm) + blackgram (1 row)	205.4	17.9	275.3	96.9	1.80	52.2	5.1	37.1	39.6	0.43
Paired planting of pigeonpea (40/80 cm × 20 cm) + blackgram (2 rows)	209.3	17.5	269.1	95.8	1.74	50.0	4.8	35.5	38.4	0.40
SEm±	3.1	0.4	3.9	1.5	0.04	1.0	0.1	0.7	0.7	0.01
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Integrated nutrient management										
Control	186.2	14.1	198.6	90.6	1.20	43.5	3.4	25.0	34.9	0.27
100% RDF	199.2	16.6	257.2	95.5	1.67	48.4	4.6	31.8	38.0	0.37
50% RDF + 50% NVC	200.6	17.0	263.3	95.9	1.72	49.0	4.8	32.7	38.4	0.38
100% RDF + 50% NVC	209.8	18.3	287.9	97.5	1.89	52.3	5.1	38.0	39.4	0.44
50% RDF + 100% NVC	205.4	17.4	276.1	97.1	1.72	51.1	4.9	34.7	39.0	0.39
100% RDF + 5 kg Zn/ha	204.1	17.2	270.8	96.9	1.68	50.7	4.8	33.4	38.8	0.39
50% RDF + 50% NVC + 5 kg Zn/ha	213.9	20.6	308.8	99.0	2.01	53.6	5.4	40.4	40.3	0.47
100% RDF + 50% NVC + 5 kg Zn/ha	216.7	21.6	318.7	100.7	2.10	56.8	6.0	46.1	41.3	0.52
50% RDF + 100% NVC+5 kg Zn/ha	215.2	20.9	313.4	99.7	2.07	54.6	5.7	44.6	40.7	0.50
SEm±	1.4	0.3	3.4	1.3	0.03	1.0	0.1	0.6	0.7	0.01
CD (P=0.05)	3.9	0.9	9.6	3.8	0.08	2.8	0.3	1.7	2.1	0.02

Table 2. Economics of pigeonpea as influenced by cropping system and integrated nutrient management (Pooled data of two years)

Treatment	Cost of cultivation (× 10^3 ₹/ha)	Gross returns (× 10^3 ₹/ha)	Net returns (×10^3 ₹/ha)	B:C ratio	MAI (×10^3 ₹/ha)
Cropping system					
Pigeonpea sole (60 × 20 cm)	17.9	102.9	82.3	4.0	-
Normal planting of pigeonpea (60 × 20 cm) + blackgram (1 row)	17.9	120.1	99.4	4.8	31.6
Paired planting of pigeonpea (40/80 cm × 20 cm) + blackgram (2 rows)	17.9	117.2	96.6	4.7	28.4
SEm+	-	1.9	1.9	0.09	0.9
CD (P=0.05)	-	7.3	7.3	0.36	3.5
Integrated nutrient management					
Control	17.9	81.6	63.7	3.6	7.9
100% RDF	19.5	106.9	87.4	4.5	17.1
50% RDF + 50% NVC	20.5	109.5	88.9	4.3	17.7
100% RDF + 50% NVC	21.3	118.7	97.4	4.6	23.1
50% RDF + 100% NVC	22.3	110.9	88.6	4.0	17.8
100% RDF + 5 kg Zn/ha	19.7	108.8	89.2	4.5	17.5
50% RDF + 50% NVC + 5 kg Zn/ha	20.7	124.9	104.2	5.0	24.1
100% RDF + 50% NVC + 5 kg/Zn ha	21.5	130.7	109.3	5.1	27.6
50% RDF + 100% NVC + 5 kg Zn/ha	22.5	128.5	106.0	4.8	27.2
SEm+	-	1.6	1.6	0.08	0.7
CD (P=0.05)	-	4.5	4.5	0.22	1.9

treatment of integrated nutrient management. However, the highest value of these nutrients were recorded with 100% RDF + 50% NVC + 5 kg Zn/ha, it was found statistically at par with 50% RDF + 100% NVC + 5 kg Zn/ha. This might be due to higher content of nutrients under this fertility level, which is the result of root proliferation by stimulating the cellular activities and translocation of certain growth stimulating compounds to roots. Thus, the extensive root system development with the balanced fertilization along with organic in adequate amount might have assisted the efficient absorption and utilization of other nutrients (Sutaria *et al*., 2010).

Productivity of blackgram

Growth, yield attributes and grain yield of blackgram was not significantly influenced by both the intercropping system. However, maximum values of these parameters were recorded with normal intercropping system (Table 1). This might be due to ascribed to differential growth habit of both crops and noncompetitive environment. Kumar and Rana (2007) also observed similar results. Further pooled data showed that application of 100% RDF + 50% NVC + 5 kg Zn/ha registered the maximum growth, yield attributes and grain yield of blackgram (Table 1). However, this treatment was on par with 50% RDF + 100% NVC + 5 kg Zn/ha. The treatment of 100% RDF + 50% NVC + 5 kg Zn/ha increased the grain yield by 92.6% over control. This could be attributed to the fact that added fertilizers enhanced the availability of these nutrients to plants. This might have resulted in profuse shoot and root growth, and thereby activating greater absorption of these nutrients from soil and improved growth and yield attributes and finally grain yield of blackgram (Goud and Kale, 2010).

Total nutrient uptake by blackgram

Both the intercropping systems failed to cause any significant variation on total uptake of N, P, K, S and Zn (Table 3). However higher values of these nutrients were under normal intercropping system followed by paired intercropping system. Application of 100% RDF + 50% NVC + 5 kg Zn/ha gave the maximum total uptake of N, P, K,S and Zn being at par with 50% RDF + 100% NVC +5 kg Zn/ha. It may be noted that fertilization increases the cation exchange capacity of roots and thus make them more efficient in absorbing nutrient (Tamhane *et. al*., 1964). The findings corroborate the report of Singh *et al*. (2008).

N/P/K/S efficiency ratio and physiological efficiency index

The lowest N, K and Zn efficiency ratio and physiological efficiency index were observed under normal intercropping (Fig. 1 and 2). Whereas, lowest P efficiency ratio and physiological efficiency index was recorded under paired intercropping. Application of 100% RDF +

Table 3. Total nutrient uptake as influenced by cropping systems and integrated nutrient management (Pooled data of two years)

Treatment	Pigeonpea					Blackgram				
	Total uptake (kg/ha)					Total uptake (kg/ha)				
	N	P	K	S	Zn	N	P	K	S	Zn
Cropping system										
Pigeonpea sole (60 × 20 cm)	119.7	17.3	83.6	14.2	0.15	-	-	-	-	-
Normal planting of pigeonpea (60 × 20 cm) + blackgram (1 row)	112.9	16.2	79.4	13.2	0.14	28.2	3.3	27.0	2.30	0.065
Paired planting of pigeonpea (40/80cm × 20 cm) + blackgram (2 rows)	108.8	15.4	77.2	12.7	0.14	25.5	3.0	25.2	2.09	0.059
SEm±	2.0	0.3	1.4	0.3	0.002	0.59	0.07	0.86	0.050	0.001
CD (P=0.05)	7.9	1.1	5.5	0.9	0.010	NS	NS	NS	NS	NS
Integrated nutrient management										
Control	70.7	9.6	49.6	7.2	0.10	16.5	2.0	19.2	1.45	0.039
100% RDF	103.5	14.2	76.5	11.9	0.13	24.0	2.8	24.1	1.93	0.054
50% RDF + 50% NVC	106.6	14.7	78.0	12.4	0.13	25.0	2.9	24.8	2.01	0.056
100% RDF + 50% NVC	121.3	17.1	84.2	14.4	0.14	28.1	3.3	26.7	2.29	0.062
50% RDF + 100% NVC	110.2	15.3	81.0	13.1	0.14	26.0	3.1	25.6	2.11	0.059
100% RDF + 5 kg Zn/ha	107.1	14.9	79.4	12.7	0.15	25.5	3.0	25.2	2.07	0.062
50% RDF + 50% NVC + 5 kg Zn/ha	130.5	19.7	88.1	15.6	0.17	30.1	3.5	28.4	2.44	0.071
100% RDF + 50% NVC + 5 kg Zn/ha	139.5	21.2	93.3	16.9	0.18	34.4	4.1	31.4	2.84	0.078
50% RDF + 100% NVC + 5 kg Zn/ha	135.1	20.5	90.8	16.3	0.17	32.5	3.8	29.8	2.66	0.075
SEm±	1.7	0.3	1.2	0.2	0.002	0.5	0.1	0.7	0.04	0.001
CD (P=0.05)	4.9	0.8	3.4	0.6	0.006	1.5	0.2	1.2	0.12	0.003

50% NVC + 5 kg Zn/ha has recorded lowest NPKS and Zn efficiency ratio and physiological efficiency index followed by 50% RDF + 100% NVC + 5 kg Zn/ha and 50% RDF + 50% NVC + 5 kg Zn/ha. Results are in line with the findings of Rana *et al*. (2006).

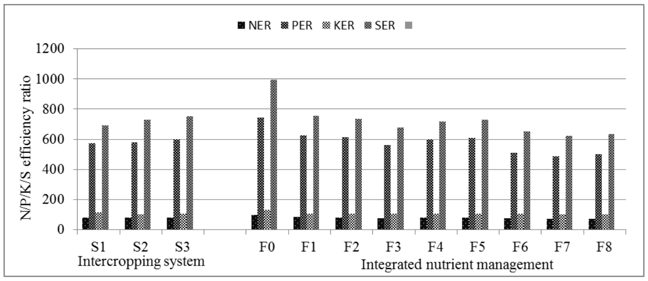

Fig. 1. N-P-K-S efficiency ratio as influenced by cropping system and integrated nutrient management (Mean data of two years)

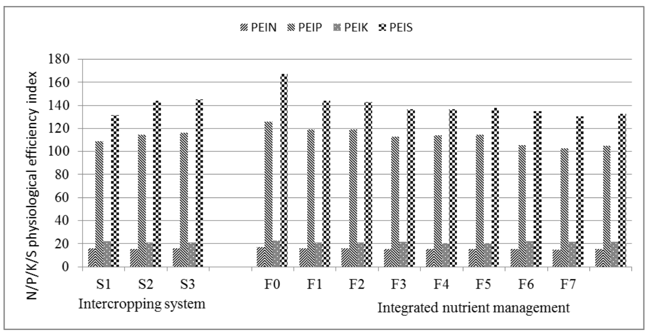

Fig. 2. N-P-K-S physiological efficiency index as influenced by cropping system and integrated nutrient management (Mean data of two years)

S and Zn uptake by cropping system

Pooled data of 2 years presented in table 4 and 5 showed that intercropping system had significant effect on nutrient uptake by cropping system. The maximum S and Zn uptake were recorded with normal intercropping and found equally effective with paired intercropping but significantly superior to sole pigeonpea (Table 5). This might be due to compound effect of grain and stover yield of their content. Similar, results were also reported by Kumar and Rana (2007) and Kumar *et al*. (2012). Among the integrated nutrient management levels, application of 100% RDF + 50% NVC + 5 kg Zn/ha recorded the highest S and Zn uptake by cropping system, which was on par with that of 50% RDF + 100% NVC + 5 kg Zn/ha. It may be due to higher biological production and development root system with enhanced root activity (Vasanthi and Subramanian, 2004). It is also evident that yields were deciding factors for the uptake of nutrients by crop.

Available soil nutrients and balance sheet

Among the intercropping system tested, no significant difference was observed for available soil S and Zn after harvest of crop. Whereas, maximum value of these nutrients were recorded under sole pigeonpea followed by normal intercropping and lowest with paired intercropping (Table 4 and 5). The lowest actual gain of S and Zn were recorded with paired intercropping followed by normal

Table 4. Balance sheet of soil S (kg/ha) as influenced by cropping system and integrated nutrient management (Mean data of two years)

Treatment	Initial S status (a)	S added (b)	S uptake by cropping system (c)	Soil S status after harvest (d)	Actual gain (a-d)	S Balance (a+b)-(c+d)
Cropping system						
Pigeonpea sole (60 × 20 cm)	18.7	20.00	14.21	20.37	-1.67	4.12
Normal planting of pigeonpea (60 × 20 cm) + blackgram (1 row)	18.7	20.00	15.52	19.91	-1.21	3.27
Paired planting of pigeonpea (40/80 cm × 20 cm) + blackgram (2 rows)	18.7	20.00	14.78	19.63	-0.93	4.29
SEm±	-	-	0.24	0.36	-	-
CD (P=0.05)	-	-	0.95	NS	-	-
Integrated nutrient management						
Control	18.7	0.00	8.21	17.45	1.25	-6.96
100% RDF	18.7	20.00	13.23	19.31	-0.60	6.16
50% RDF + 50% NVC	18.7	13.74	13.77	19.42	-0.72	-0.75
100% RDF + 50% NVC	18.7	23.74	15.92	20.13	-1.43	6.40
50% RDF + 100% NVC	18.7	17.47	14.49	19.91	-1.21	1.77
100% RDF + 5 kg Zn/ha	18.7	20.00	14.02	19.64	-0.94	5.04
50% RDF + 50% NVC + 5 kg Zn/ha	18.7	13.74	17.17	20.76	-2.06	-5.49
100% RDF + 50% NVC + 5 kg Zn/ha	18.7	23.74	18.60	21.86	-3.16	1.91
50% RDF + 100% NVC + 5 kg Zn/ha	18.7	17.47	18.11	21.27	-2.57	-3.13
SEm±	-	-	0.21	0.28	-	-
CD (P=0.05)	-	-	0.58	0.80	-	-

Table 5. Balance sheet of soil Zn (kg/ha) as influenced by cropping system and integrated nutrient management (Mean data of two years)

Treatment	Initial Zn Status (a)	Zn Added (b)	Zn uptake by cropping system (c)	Soil Zn status after harvest (d)	Actual gain (a-d)	Zn Balance (a+b)-(c+d)
Intercropping system						
Pigeonpea sole (60 × 20 cm)	1.15	5.00	0.15	1.47	-0.32	4.53
Normal planting of pigeonpea (60 × 20 cm) + blackgram (1 row)	1.15	5.00	0.21	1.45	-0.30	4.49
Paired planting of pigeonpea (40/80 cm × 20 cm) + blackgram (2 rows)	1.15	5.00	0.20	1.43	-0.28	4.52
SEm±	-	-	0.003	0.011	-	-
CD (P=0.05)	-	-	0.014	NS	-	-
Integrated nutrient management						
Control	1.15	0.00	0.11	1.13	0.02	-0.09
100% RDF	1.15	0.00	0.16	1.39	-0.24	-0.41
50% RDF + 50% NVC	1.15	0.04	0.17	1.42	-0.27	-0.40
100% RDF + 50% NVC	1.15	0.04	0.18	1.44	-0.29	-0.43
50% RDF + 100% NVC	1.15	0.08	0.18	1.45	-0.30	-0.40
100% RDF + 5 kg Zn/ha	1.15	5.00	0.19	1.53	-0.38	4.43
50% RDF + 50% NVC + 5 kg Zn/ha	1.15	5.04	0.21	1.54	-0.39	4.43
100% RDF + 50% NVC + 5 kg Zn/ha	1.15	5.04	0.23	1.59	-0.44	4.37
50% RDF + 100% NVC + 5 kg Zn/ha	1.15	5.08	0.22	1.57	-0.42	4.44
SEm±	-	-	0.003	0.010	-	-
CD (P=0.05)	-	-	0.009	0.026	-	-

intercropping, whereas, maximum with sole pigeonpea. The balance sheet computed maximum of S and Zn balance was recorded with sole pigeonpea. Among the different treatments, application of 100% RDF + 50% NVC + 5 kg Zn/ha gave the significantly higher available S and Zn after harvest of the crops. This was closely followed by application of 50% RDF + 100% NVC + 5 kg Zn/ha. Application of organic manures with inorganic fertilizers improve the soil structure, aeration, buffering capacity, water holding capacity, influences solubility of the mineral and provide energy for growth and development of microorganisms (Bandyopadhyay and Puste, 2002). All these may lead to increase in nutrients (N,P,K,S and Zn) availability of soil in the plot receiving combined application of inorganic and vermicompost along with zinc. The actual gain of S and Zn was recorded negative in all the integrated nutrient levels except control. The maximum negative value of S and Zn was obtained with the application of 100% RDF + 50% NVC + 5 kg Zn/ha followed by 50% RDF + 100% NVC + 5 kg Zn/ha during both the years of study. Whereas, maximum positive value of S was recorded with 100% RDF + 50% NVC. The maximum positive value of Zn was recorded with the application of 100% RDF + 5 kg Zn/ha and followed by 50% RDF + 50% NVC + 5 kg Zn/ha.

Intercropping of pigeonpea (60 × 20 cm) with blackgram (1 row) and application of 100% RDF + 50% NVC + 5 kg Zn/ha to pigeonpea was found more productive and remunerative than pigeonpea sole croppng under rainfed conditions of eastern Uttar Pradesh.

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